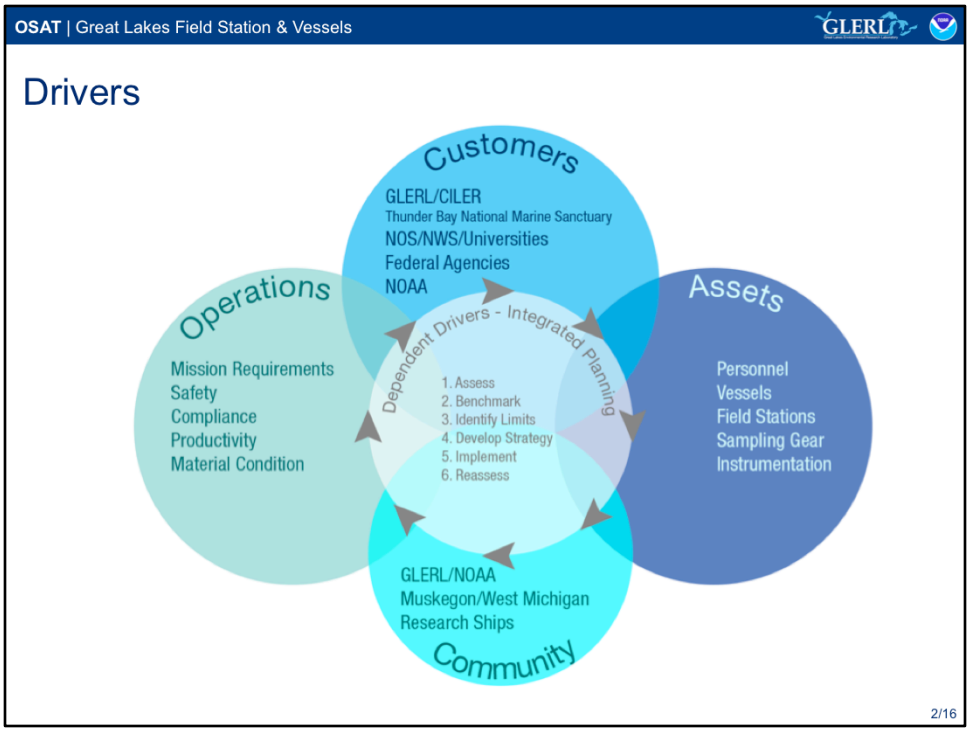
This work aligns with the following NOAA Goals:
Science: Climate Adaptation and Mitigation
Improved scientific understanding of the changing climate system and its impacts
Assessments of current and future states of the climate system that identify potential impacts and inform science, service, and stewardship decisions
Mitigation and adaptation efforts supported by sustained, reliable, and timely climate services
A climate-literate public that understands its vulnerabilities to a changing climate and makes informed decisions
Science: Weather-Ready Nation
Reduced loss of life, property, and disruption from high-impact events
Improve freshwater resource management
Improve transportation efficiency and safety
Healthy people and communities due to improved air and water quality services
A more productive and efficient economy through information relevant to key sectors of the U.S. economy
Science: Healthy Oceans
Improved understanding of ecosystems to inform resource management decisions
Recovered and healthy marine and coastal species
Healthy habitats that sustain resilient and thriving marine resources and communities
Sustainable fisheries and safe seafood for healthy populations and vibrant communities
Science: Resilient Coastal Communities and Economies
Resilient coastal communities that can adapt to the impacts of hazards and climate change
Comprehensive ocean and coastal planning and management
Safe, efficient and environmentally sound marine transportation
Improved coastal water quality supporting human health and coastal ecosystem services
Education: Science-Informed Society
Youth and adults from all backgrounds improve their understanding of NOAA-related sciences by participating in education and outreach opportunities
Formal and informal education organizations integrate NOAA-related science content and collaborate with NOAA scientists on the development of exhibits, media, materials, and programs that support NOAA's mission
Education: Safety and Preparedness
Youth and adults from all backgrounds are aware of, prepare for, and appropriately respond to environmental hazards that impact health, safety, and the economy in their communities
Education: Organizational Excellence



GLERL's LMFS and Vessel Operations are coordinated to provide safe, reliable, and innovative service to support integrated scientific research for NOAA and external partners. In addition, both the field station and vessels provide opportunities for communication, outreach, and education for NOAA and partners, academic institutions, and local and regional communities. Integral to GLERL's Vessel Operations is planning for short-term and future needs, driven primarily by scientific goals and objectives.

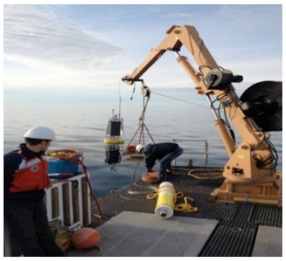
Guiding Principles

- Facilitate the conduct of field science (e.g., observations and process studies) that meet the requirements for GLERL researchers, NOAA interests in the Great Lakes, and partner institutions.
- Achieve safety and regulatory compliance in all aspects of operations and asset management.
- Maintain uninterrupted vessel service by addressing unmet needs on a proactive basis.
- Establish resources and systems for best management of vessel material condition and platform effectiveness.
- Advance marine technology initiatives that support NOAA's stewardship and operational goals.
- Invest in personnel development and create career path opportunities.
- Embrace the "One NOAA" concept through support of all NOAA interests in the Great Lakes region and contribute to NOAA's priorities for vessel management.
- Provide value as a national, regional, and community resource.

To address the challenges encountered in the operation of GLERL's vessels, consideration is given to the following business elements: addressing customer needs, providing effective capital and asset management, developing operations, and serving community. Simultaneous examination of these elements provides a holistic and sustainable long-term strategy to meet GLERL's research needs as well as those of other Great Lakes customers.

- Addressing Customer Requirements and Needs: Identify customers, partners, relationships, and responsibilities in the Great Lakes region.
- Management of Assets: Create a vessel inventory and fleet renewal plan based on customer requirements and best management of assets. As part of this element, maintain development of LMFS facility infrastructure in support of long term group activities e.g., scientific research and outreach.
- Development of Operations: Define resource capabilities and professional development plans accounting for long-term product development, vessel and customer requirements.
- Serving Community: Ensure peer and public engagement in the operations of vessels supporting research and outreach that is integrated with local, national, and regional community initiatives.

One NOAA - Regional Vessel Support



Great Lakes Environmental Research Lab

Thunder Bay National Marine Sanctuary

National Ocean Service Mussel Watch

National Data Buoy Center

Office of Response and Restoration

Moon pool for mounting instrumentation

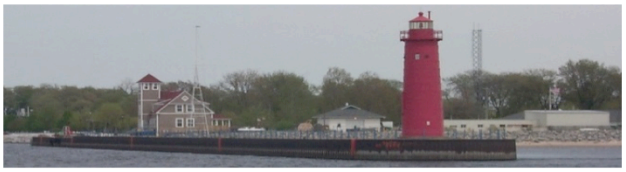
Office of Coast Survey

National Weather Service

3/16

Lake Michigan Field Station
Home Port – Great Lakes Vessel Operations

- 1200’ Deep water dockage
- Small boat basin
- Logistics
- Engineering
- Fabrication
- Biodiesel fueling
- Community outreach



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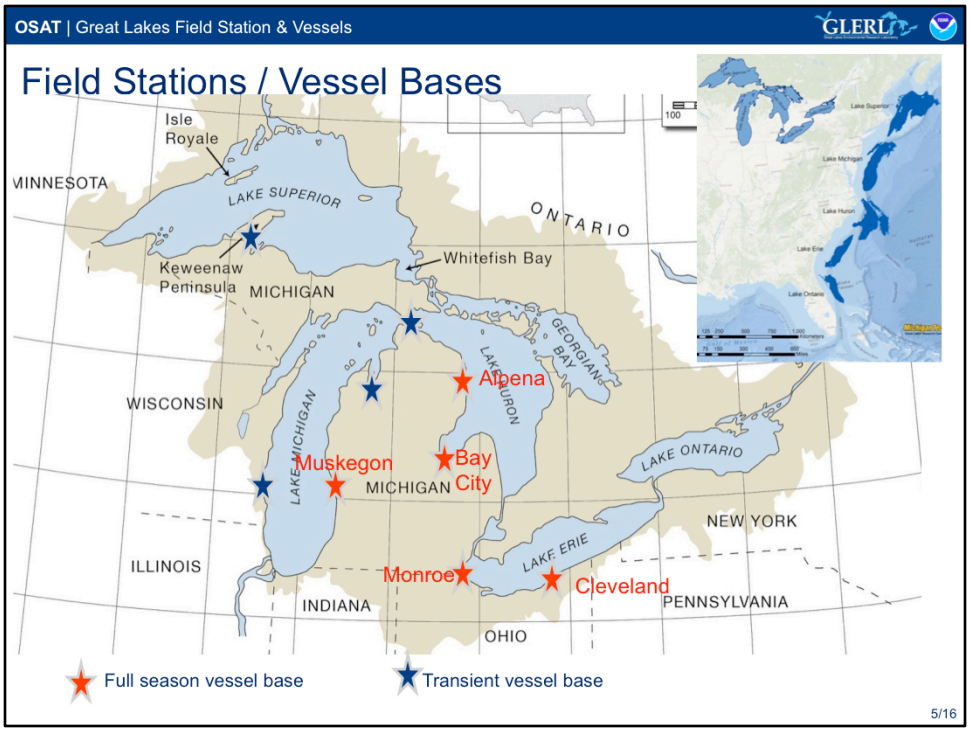
OSAT | Great Lakes Field Station & Vessels
GLERL
Field Stations / Vessel Bases
Isle Royale
MINNESOTA
LAKE SUPERIOR
ONTARIO
Keweenaw Peninsula
MICHIGAN
Whitefish Bay
GEORGIAN BAY
LAKE HURON
Alpena
WISCONSIN
LAKE MICHIGAN
Muskegon
Bay City
MICHIGAN
LAKE ONTARIO
NEW YORK
LAKE ERIE
ILLINOIS
Monroe
Cleveland
INDIANA
PENNSYLVANIA
OHIO
Full season vessel base
Transient vessel base
5/16

SRV - Laurentian

- Built 1974 - UNOLS
- Operated by GLERL since 2002
- Multi discipline platform
  - 20 day duration
  - 14 berths
  - Heavy lift and trawl capable
  - Limited Winter season
- Fueled by B100 Biodiesel

Primary platform for GLERL programs

- Long Term Research monitoring
- Spatial studies
- Plankton Survey System (PSS)
- MOCNESS
- Winter operations
- Outreach and education

Supports NOAA regional missions

- Deep water hydrographic surveys
- Archeological exploration
- NDBC buoy support

Realities

- Nearing end of service life
- Ownership limits capital improvements
- Dated infrastructure and technology
- Scheduling challenges
  - Choice of one
  - No viable backup, reserve capacity

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SRV – Small Research Vessel

UNOLS – University-National Oceanographic Laboratory System

LTR | Long Term Research, a program led by GLERL's EcoDyn's team that integrates a core set of long-term observations on biological, chemical, and physical variables on Lake Michigan, accompanied by process studies and field experiments, for understanding and forecasting change on the Great Lakes ecosystem. The term is used in the context of a site and in particular, regarding the Lake Michigan LTR program, that is, the LTR program on southern Lake Michigan. although we currently have research programs on other lakes, none are consistent or extensive enough through all seasons to characterize them as LTR sites.

MOCNESS | Multiple Opening Closing Net and Environmental Sensing System is an apparatus used for fine-scale sampling of Bythotrephes, Mysis, and larval fishes

NDBC – National Data Buoy Center

Strategy for the next 50 years

- Address Regional Gaps
  - Ice strengthened hull
  - Full SRV capabilities
  - Hydro Survey Capable
  - Dynamic Positioning
  - Laboratories and infrastructure to best support Science initiatives

- NOAA Regional asset
- Collaborative management plan

Length 90 -110 feet
Beam - 29 feet
Speed - 15 knots
Draft – 7' 2"
Propulsion – Twin 600 hp
Bow thruster
Twin 99kw generators
Berthing 12-14
Endurance 7-10 days

ReCON | Real-time Coastal Observation Network is a project focused on the development of a national network of low cost coastal buoys capable of seabed to sea-surface observations. ReCON is built upon a wireless Internet observation system, with each system collecting meteorological data and providing sub-surface measurements of chemical, biological, and physical parameters.

GLOS | Great Lakes Observing System is one of 11 Regional Associations of the Integrated Ocean Observing System (IOOS®), working to enhance the ability to collect, deliver, and use ocean and Great Lakes information. IOOS is a partnership among federal, regional, academic and private sector parties that works to provide new tools and forecasts to improve safety, enhance the economy, and protect our environment.

HAB | Harmful Algal Bloom is the proliferation of cyanobacteria or algae resulting from rapid growth in response to high nutrient and/or light levels. These events can have severe impacts on the ecology of systems where they occur as well as on the socioeconomics of surrounding regions and the health of humans, wildlife, pets and livestock.

ESP | Environmental Sample Processor is the current state-of –the-art instrumentation providing an in situ platform for identifying and quantifying marine organisms and their gene products. This electromechanical/fluidic instrument is designed to collect discrete water samples, concentrate microorganisms, and autonomously analyze samples utilizing molecular probe assays that will help in expanding our scientific understanding of the cyanobacterial community composition and toxicity during harmful algal blooms (HABs) in western Lake Erie.

Class II Vessels (25-40') - 4

- Near shore support / sampling
- Hydro survey capable
- Dive operations
- Event response
- Remote locations
- Side Scan / Multi-beam sonar capable
- AC and hydraulic power

Since 2013, all Class II Vessels have been completely rebuilt by the Lake Michigan Field Station staff.

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Vessel Operations Guiding Principles

- **Stewardship**
  - **Cultural Heritage - LMFS**
  - **Environmental - Alternative Fuels**
  - **Asset management**
- **Best Management Practices**
  - **Manage by metrics – benchmarks**
  - **Cost and productivity**
  - **Customer focus**
- **Leadership / Engagement**

- Maritime Heritage Walkway
- Caretaker of oldest NOAA facility
- Public access

- Federal Green Fleet Working Group
- Committee for Marine Transportation (CMTS) Alternative Fuels Task Team
- Federal Green Fleet Working Group
- UNOLS Green Fleet
- Cooperative programs – MARAD, Corps of Engineers

- Resource for vessel reutilization
  - OAR, NOS, NMFS
  - “Laidley”, “Grayling” projects

- NOAA Small Boat Program
- Great Lakes Association of Science Ships
- NOAA Regional Vessel Working Group

11/16

Vessel Support Capabilities



- Best use of available funds
- Invest in employee skill sets and talent
- Rebuild to mission requirements
- Integrate emerging technologies
- Reduce operational downtime


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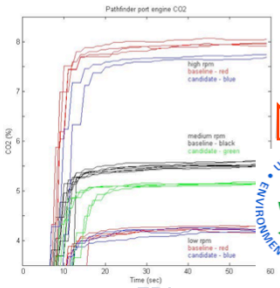
Technology Exchanges

Industry
Validation

GLERL
Proof of Concept
Focal point

Maritime Administration
Large Power Plants



EPA
Emissions Studies

US Army Corps of Engineers

Corps of Engineers
Increase Scale

14/16

Technology Objective
Balance Operations and Innovations

Accomplish Current Mission	–	**Anticipate Future Opportunities**
Support Traditional Sampling	–	**Provide for Emerging Technologies**
Optimized Platform	–	**Maintain Versatility**
Support Science Direction	–	**Offer Alternatives**

Offshore cable laying

Multi-beam installation

Transducer well – R8001

High speed transducer fairing

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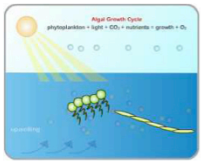
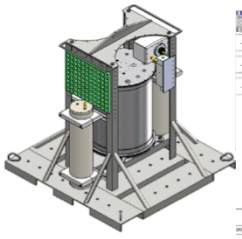
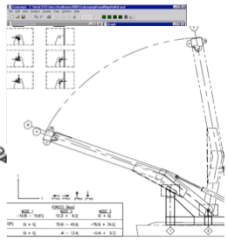
Vessel Support and Science Objectives

HABs ESP Lander

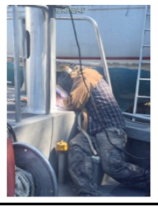






Science Objective → Lander Design Version #6 → Computer Engineering → Physical Model Validation

- Early Risk Mitigation
- Define Operational Margins
- Develop Engineering Controls
- Implement Platform Enhancements
- Provide Alternatives



- Platform Modifications
- Alternative Platforms

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Vision for vessel operations

1. Enhance current initiatives
   - Personnel development
   - Evaluation of emerging technologies
   - Marine technology and operations leadership
   - Contributions to Regional and National vessel interests
2. Facilitate 2, 5 and 10 year field project planning
3. Organize NOAA Regional vessel requirements and create a *comprehensive* and *sustainable* management plan
4. Consolidate NOAA support for a new Regional SRV

Questions?
Feedback?